

# CE 103: Surveying

## Lecture 4: Leveling (Contd.)

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# Outline

- ❑ Levelling instruments
- ❑ Level and levelling staff
- ❑ Levelling related math problem

## 4.4 Levelling Instruments

The instruments commonly used in direct levelling are-

- **A Level:** This machine is a telescope which is horizontally mounted on a tripod stand. This telescope is free to move in  $360^\circ$  rotation in the horizontal plan. The viewing glass near the eye is called eye piece, and the viewing glass facing the object is called object piece. The line (imaginary) which joins the centres of the eye piece and object lens, is called the line of collimation.
- **A levelling Staff:** It is a collapsible wooden or aluminum staff on which m, cm & mm are marked.



Image result for A level and staff

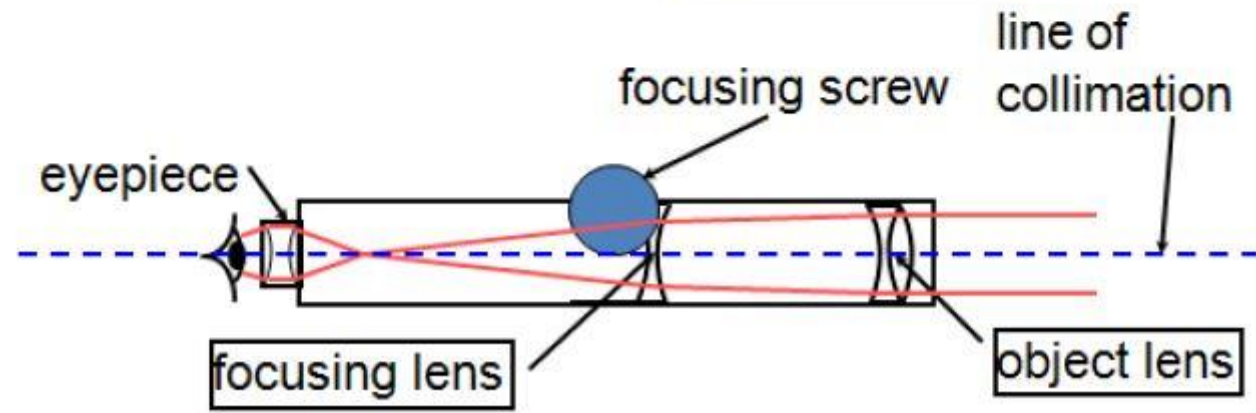
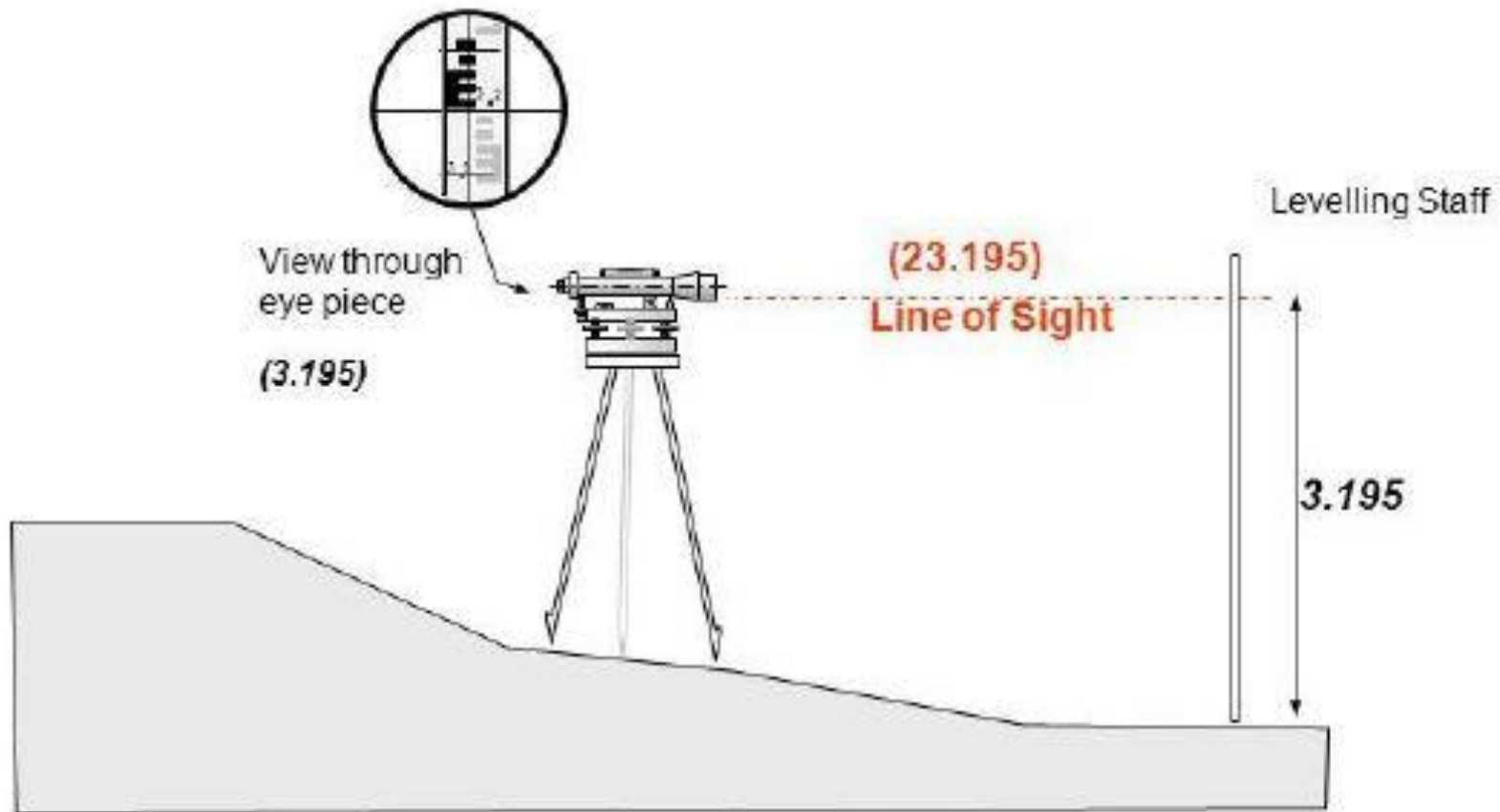


Figure 1: A level



**Figure 2: A levelling staff**



**Figure 3: Taking reading with a level and a levelling staff.**

### Example 9.4

Station	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remarks
1	2.285					232.460	B.M. 1
2	1.650		?	0.020			
3		2.105			?		
4	?		1.960	?			
5	2.050		1.925		0.300		
6		?		?		232.255	B.M. 2
7	1.690		?	0.340			
8	2.865		2.10		?		
9			?	?		233.425	B.M. 3

Station	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remarks
1	2.285					232.460	B.M. 1
2	1.650		<b>2.265</b>	0.020		<b>232.480</b>	
3		2.105			<b>0.455</b>	<b>232.025</b>	
4	<b>1.625</b>		1.960	<b>0.145</b>		<b>232.170</b>	
5	2.050		1.925		0.300	<b>231.870</b>	
6		<b>1.665</b>		<b>0.385</b>		232.255	B.M. 2
7	1.690		<b>1.325</b>	0.340		<b>232.595</b>	
8	2.865		2.10		0.410	<b>232.185</b>	
9			<b>1.625</b>	<b>1.240</b>		233.425	B.M. 3



9.4

$$\textcircled{2} \rightarrow FS = BS - Rise = 2.285 - 0.02 = \boxed{2.265}$$

$$RL = RL' + Rise = 232.46 + 0.02 = \boxed{232.48}$$

$$\textcircled{2} \rightarrow FI = IS - BS' = 2.105 - 1.65$$

$$\textcircled{2} \rightarrow FS = BS - Rise = 2.285 - 0.02 \\ = \boxed{2.265}$$

$$RL = RL' + Rise = 232.46 + 0.02 = \boxed{232.48}$$

$$\textcircled{3} \rightarrow Fall = IS - BS' = 2.105 - 1.65 \\ = 0.455$$

$$RL = RL' - Fall = 232.48 - 0.455 \\ = \boxed{232.025}$$

$$\textcircled{4} \rightarrow Rise = IS' - FS' = 2.105 - 1.96 \\ = \boxed{0.145}$$

$$RL = RL' + Rise = \cancel{232.15} + 232.025 + 0.145 \\ = \boxed{232.17}$$

⑤ →

$$RL = RL' - \text{Fall} = 232.17 - 0.3 \\ = \boxed{231.87}$$

Previous BS = FS - Fall =  $1.925 - 0.3$   
 $= \boxed{1.625} \rightarrow \textcircled{4}$

⑥ →

$$\text{Rise} = RL - RL' \\ = 232.55 - 231.87 \\ = \boxed{0.385}$$

$$IS = BS' - \text{Rise} = 2.05 - 0.385 \\ = \boxed{1.665}$$

$$IS = BS' - Rise = 2.05 - 0.385$$

$$= \boxed{1.665}$$

$$\textcircled{7} \rightarrow RL = RL' + Rise$$

$$= 232.255 + 0.34 = \boxed{232.595}$$

$$FS = IS' - Rise = 1.665 - 0.34$$

$$= \boxed{1.325}$$

$$\textcircled{8} \rightarrow RL = RL' - Fall = 232.595 - 0.41$$

$$= \boxed{232.185}$$

$$\textcircled{9} \rightarrow Rise = RL - RL' = 233.925 - 232.185$$

$$= \boxed{1.24}$$

$$FS = BS' - Rise = 2.865 - 1.24$$

$$= \boxed{1.625}$$